

INTERACTIVE AUTOMOTIVE REARVISION SYSTEM

This application claims priority from pending U.S. provisional Pat. application entitled INTERACTIVE AUTOMOTIVE REARVISION SYSTEM, filed March 27, 2000, Ser. No. 60/192,721, the disclosure of which is hereby incorporated herein by reference in its entirety.

TECHNICAL FIELD AND BACKGROUND OF THE INVENTION

The interior rearview mirror assembly is a particularly good location in the vehicle cabin to locate an information display or to locate a user interface device, such as a manually actuated button.

However, the driving task for a vehicle is complex. Presentation to, use of and assimilation by the driver of a plurality of input buttons and/or displays is challenging for the driver. Also, the user interface area/display area available at the rearview mirror location is finite, and may not be able to optimally accommodate all the functions, displays and interfaces desired to be located at, on or within the interior rearview mirror assembly. Thus, an objective of this present invention is to provide an interactive rearview mirror assembly that allows the driver to readily and safely access a plurality of displays and functions in a manner that is convenient to the driver and such that the rearview mirror assembly functions well both as a display/interface location and as a rear vision device that provides a rearward field of view adequate for safe driving on a highway.

SUMMARY OF INVENTION

According to the present invention, an interactive interior mirror system is provided that maximizes the driver's (or other occupants of the vehicle) ability to engage in activities or be informed relative to some information, internal or external to the vehicle, while minimizing the distraction the driver.

In one form of the invention, a vehicular mirror system includes a mirror assembly with a mirror casing having a reflective element with a rearward field of view when the mirror assembly is mounted to a vehicle. The mirror casing includes a mounting portion that is adapted to mount the mirror casing to the vehicle. At least one user-actuatable selector element is provided at the reflective element for access by a driver of the vehicle. The mirror

assembly further includes at least one display element, which is actuatable to display at least one image in response to the selector element being actuated by the driver.

In one aspect, the selector element comprises a touch actuatable element. In further aspects, the mirror assembly includes a plurality of the selector elements. Optionally each selector element is associated with a function or a family of functions and, most preferably, a family of related functions or a plurality of a family of functions. The functions may include (i) telephone information, including video teleconferencing or telematics images (ii) highway status information, (iii) blind spot information, (iv) hazard warning information, including train approaching information or warning, (v) vehicle status information, (vi) page messaging information, (vii) speedometer information, (viii) tachometer display, (ix) remote transaction information, including toll transaction information, (x) audio system information, (xi) fuel gauge information, (xii) heater control information, (xiii) air conditioning system information, (xiv) status of inflation of tires information, (xv) trailer tow image information, (xvi) e-mail message information, (xvii) compass information, (xviii) engine coolant temperature information, (xix) oil pressure information, (xx) cellular phone operation information, (xxi) global positioning system information (GPS), (xxii) weather information, (xxiii) temperature information, including internal and external temperature information, (xxiv) traffic information, (xxv) telephone number information, (xxvi) fuel status information, (xxvii) battery condition information, (xxviii) time information, including time zone information, (ixxx) stock information, or the like. Optionally, the selector element is re-configurable so that the selector elements may be customized to suit the particular driver's needs. For example, one of the selector elements may comprise a function setting selector for the other selector elements or the selector elements may be reconfigured using an onboard computer.

For example, more than one of the selector elements may actuate a display element whereby the display element associated with the interior rear view mirror assembly may display more than one type of image. For example, the display element may display video images in response to a telematics selector element, a camera selector element, such as a baby minder selector element, a forward vision selector element, a rear vision selector, a blind spot or reverse aid selector element, or scrolling information, such as stock quotes, weather information, page messaging information, email information, video conferencing, such as by a video phone, vehicle information status or the like, in response to a stock quote selector element, a weather selector element, a page messaging selector element, a

GPS/navigation system information selector element, an email selector element, or a vehicle status selector element being actuated.

In one aspect, the selector elements comprise touch sensitive elements, such as backlit touch sensitive elements. For example, the touch sensitive elements may include associated therewith a display element. For example, a display element may be mounted to an outer surface of the reflective element with the touch sensitive element mounted over the display element. More preferably, the display element may be mounted to an inner surface of a reflective element with a touch sensitive element mounted over a portion of the reflective element over the display element or in proximate association therewith. In another form, the selector elements are mounted to the mirror casing, such as at the bezel or perimeter portion of the mirror casing which extends around the reflective element or may be mounted in a mirror mount or an accessory module associated with or proximate to the mirror assembly.

According to another form of the invention, an interactive vehicular mirror system includes an interior rearview mirror assembly, a display element, and a user actuatable selector element. The interior rearview mirror assembly includes a mirror casing and a reflective element and is adapted to mount to an interior portion of a vehicle, with the reflective element having a rearward field of view when the interior rearview mirror assembly is mounted to the vehicle. The user actuatable selector element is associated with a function and is provided at the reflective element, with the selector element activating the display element to display an image associated with the function of the selector element when the selector element is actuated. The display element is provided at the interior rearview mirror assembly.

In one aspect, the selector element is provided on an outer surface of the reflective element. For example, the selector element may be located at a lower portion of the reflective element, including a lower perimeter portion of the reflective element.

In another aspect, the display element is re-configurable whereby the display element may be associated with more than one function and/or may be electrically changeable to display multiple images, typically generated by a microprocessor control. In addition, activating the selector element may change or reconfigure the size of the image or text on the display element to suit the individual needs of the drivers, such as a senior driver.

In another aspect, the selector element comprises a touch sensitive element. For example, the touch sensitive element may be responsive to either heat, capacitance, inductance, or resistance.

In yet other aspects, the touch sensitive element preferably comprises a transparent touch sensitive element and includes one or more transparent conductive coatings, including a coating of indium tin oxide, tin oxide, doped tin oxide, or doped zinc oxide. In further aspects, the touch sensitive element comprises a plurality of coatings, such as a plurality of stacked coatings.

In another aspect, the interactive vehicular mirror system includes another display element, which is in association with and/or activatable by the selector element. The another display element is proximate to the touch sensitive element and displays an image indicating the function of the touch sensitive element when the touch sensitive element is actuated. For example, the image of the display element, which is in association with the selector element, may comprise an icon associated with the function of the selector element. In further aspects, the display element may comprise a liquid crystal display, a light emitting diode display (including an inorganic light emitting diode display and an organic light emitting diode display), a plasma display, a fluorescent display, such as a vacuum fluorescent display, and an electroluminescent display, for example.

In yet another form of the invention, an interactive vehicular mirror system includes an interior rearview mirror assembly, a plurality of display elements, and a respective plurality of user actuatable selector. The respective plurality of user actuatable selector elements are associated with the plurality of display elements and are provided at the interior rearview mirror assembly, with each of the selector elements having a function associated therewith. Each of the display elements displays an image indicating the function of a respective selector element at least when the respective selector element is actuated.

In another aspect, the system includes another display element, with at least one of the selector elements being associated with the another display element and actuating the display element to display at least one image associated with the function of the selector element when the selector element is actuated.

In one aspect, the another display element is positioned at the reflective element. For example, the display element may be positioned behind the reflective element and, further, is viewable through the reflective element at least when the display element is actuated.

In other aspects, the selector element is provided on an outer surface of the reflective element.

According to another aspect, the another display element displays at least one video image. For example, the display element may display a rearward field of view image, an internal cabin monitoring image, such as a baby minder image, a teleconferencing image, a forward facing image, a remote monitoring image, or a recorded image. Alternately or in addition, the second display element may display at least one of (i) a rain sensor operation display, (ii) a telephone information display, (iii) a highway status information display, (iv) a blind spot indicator display, (v) a hazard warning display, (vi) a vehicle status display, (vii) a page message display, (viii) a speedometer display, (ix) a tachometer display, (x) an audio system display, (xi) a fuel gauge display, (xii) a heater control display, (xiii) an air conditioning system display, (xiv) a status of inflation of tires display, (xv) a trailer tow image display, (xvi) an e-mail message display, (xvii) a compass display, (xviii) an engine coolant temperature display, (xix) an oil pressure display, (xx) a cellular phone operation display, (xxi) a global positioning system display, (xxii) a weather information display, (xxiii) a temperature display, (xxiv) a traffic information display, (xxv) a telephone number display, (xxvi) a fuel status display, (xxvii) a battery condition display, (xxviii) a time display, (xxix) a train approach warning display, and (xxx) a toll transaction display.

In another form of the invention, an interactive vehicular mirror system includes an interior rearview mirror assembly, which includes a mirror casing and a reflective element, and a display element. The interior rearview mirror assembly is adapted to mount to an interior portion of the vehicle, with the reflective element having a rearward field of view when the interior rearview mirror assembly is mounted to the vehicle and, further, a plurality of user-actuatable selector elements. Each of the user-actuatable selector elements has at least one function associated therewith. Furthermore, at least one of the selector elements is associated with with the display element and actuates the display element to display at least one image associated with the function of the selector element.

According to one aspect, the mirror system further includes an image capturing device, which is adapted for mounting to a vehicle. One of the selector elements comprises a rearvision selector element, with the image capturing device detecting an internal cabin image or an image rearward of the vehicle. The image capturing device sends an image signal based on the detected image to the display element for display by the display element when the rearvision selector element is actuated. For example, the interactive mirror system may include an exterior sideview mirror assembly, with the image capturing device positioned at the sideview mirror assembly for capturing an image rearward of the vehicle.

Accordingly, the interactive vehicular mirror system maximizes the driver's ability to engage in activities or be informed relative to some external or internal information while minimizing the distraction of the driver.

These and other objects, advantages, and features will become more apparent from a review of the description and drawings which follow.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevation view of an interactive automated rear vision system of the present invention which incorporates a display, which in the illustrated embodiment displays scrolling information;

FIG. 2 is a similar view to FIG. 1 of the interactive automotive rear vision system illustrating the display displaying different information;

FIG. 3 is another embodiment of an interactive automotive rear vision system incorporating a video display, which in the illustrated embodiment illustrates a baby view images;

FIG. 4 is a similar view to FIG. 3 of the display displaying video images of a telematic system;

FIG. 5 is a side elevation schematic view of an interactive automotive rear vision system of the present invention;

FIG. 6 is a similar view to FIGS. 1, 2, 3 and 4 illustrating a another selection of one of the selector elements;

FIG. 7 is a similar view to FIGS. 3 and 4, with the video screen displaying reverse aid images; and

FIG. 8 is a schematic cross-sectional view of an interior rearview mirror assembly of the interactive automotive rear vision system of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in the FIGS. 1-4, a plurality of user interfaces for a plurality of functions are provided as touch sensitive locations provided on the front surface of the reflective element housed in the casing of an interior mirror assembly. Interior mirror assemblies suitable to use in this present invention typically comprise a reflective element housed in a casing, and with that casing pivotably attaching to a support that mounts to a vehicle windshield or header area, such as are disclosed in U.S. Pat. Nos. 5,820,097; 5,615,857; 5,330,149; 5,100,095; 4,930,742; 4,936,533; 5,487,522; 5,615,857; and 5,671,996; which are commonly assigned to Donnelly Corporation, and which are herein

incorporated by reference in their entireties. In addition, the interior mirror assembly may include displays (such as described in pending U.S. Pat. application entitled REARVIEW MIRROR ASSEMBLY WITH ADDED FEATURE MODULAR DISPLAY, filed Nov. 24, 1999, by Timothy Skiver et al., Attorney Docket No. DON01 P-702, the disclosure of which is incorporated by reference herein in its entirety) and lights (such as map lights, such as disclosed in such as disclosed in U.S. Pat. Nos. 5,938,321; 5,813,745; 5,820,245; 5,673,994; 5,649,756; or 5,178,448, the disclosures of which are herein incorporated by reference in their entireties).

A schematic of an interactive rearview mirror system 10 is shown in FIG. 5. Mirror system 10 includes an interior mirror assembly 11, which incorporates a reflective element 12. Reflective element 12 is housed in a casing 14, which is mounted to an interior portion of a vehicle, such as vehicle windshield 24, by a support arm 18. Optionally, casing 14 is pivotably mounted to support arm 18, which attaches via a mount 20 to a mounting button 22 that is adhered to vehicle windshield 24 (note that alternately, mounting, of the assembly can be to the header region of the vehicle, as known in the mirror arts and/or can be a single pivot/ball joint or a two pivot/ball joint). Examples of suitable mounting arrangements can be found in U.S. Pat. Nos. 5,487,522; 5,671,996; 5,820,097; 5,615,857; 5,330,149; 5,100,095; 4,930,742; or 4,936,533 or co-pending U.S. Pat. Application Ser. No. 08/781,408, filed Jan. 10, 1997, all commonly assigned to Donnelly Corporation, the disclosures of which are hereby incorporated herein by reference in their entireties.

The outermost or front surface of reflective element 12 comprises a selector element, such as a touch sensitive element 26. For suitable touch sensitive elements, reference is made to U.S. Pat. Nos. 6,001,486 (Attorney Docket No. DON03 P-693); and 6,087,012 (Attorney Docket No. DON03 P-750), the disclosures of which are herein incorporated by reference in their entireties, and U.S. Pat. applications entitled ENHANCED LIGHT TRANSMISSION CONDUCTIVE COATED TRANSPARENT SUBSTRATE, Ser. No. 60/213,663, filed June 23, 2000 (Attorney Docket No. DON03 P-828); entitled PLASTIC SUBSTRATE FOR INFORMATION DEVICES, Ser. No. 60/231,096, filed Sept. 8, 2000 (Attorney Docket No. DON03 P-839); entitled REDUCED CONTRAST IMPROVED TRANSMISSION CONDUCTIVELY COATED TRANSPARENT SUBSTRATE, Ser. No. 60/239,788, filed Oct. 12, 2000 (Attorney Docket No. DON03 P-853); entitled SPACER ELEMENTS FOR INTERACTIVE INFORMATION DEVICES, Ser. No. 60/234,867, filed Sept. 22, 2000 (Attorney Docket No. DON03 P-845); entitled

IMPROVED PLASTIC SUBSTRATE FOR INFORMATION DEVICES, Ser. No. 60/244,577, filed Oct. 31, 2000 (Attorney Docket No. DON03 P-860), which are all commonly assigned to Donnelly Corporation of Holland, Mich. and incorporated by reference in their entireties herein.

5 Optionally, a display element 28 (and most preferably a reconfigurable display element) is mounted at the rearmost or outermost surface of reflective element 12 so as to be at least partially (preferably substantially and most preferably fully) viewed through reflective element 12. However, other locations for display elements are possible, such as mounting to the side of, above, or below reflective element 12, such as is disclosed in U.S.

10 Pat. application entitled INTERIOR REARVIEW MIRROR ASSEMBLY INCORPORATING A VIDEO SCREEN, filed Feb. 26, 2001, Ser. No. 09/793,002, Attorney Docket No. DON01 P-869, the disclosure of which is incorporated by reference herein in its entirety.

15 For examples of locations of such displays and/or user interfaces and/or other accessories, including video screens, which are disclosed in copending U.S. Pat. application entitled INTERIOR REARVIEW MIRROR ASSEMBLY INCORPORATING A VIDEO SCREEN, filed March 1, 2000, Ser. No. 60/186,520, Attorney Docket No. DON01 P-802, microphones and/or speakers, which are disclosed in U.S. Pat. Applications Ser. No. 09/361,814, filed Jul. 27, 1999, and 09/199,907, filed Nov. 25, 1998, sound processing systems, including digital sound processing systems, which are disclosed in U.S. Pat. Application entitled INTERIOR REARVIEW MIRROR SOUND PROCESSING SYSTEM, Ser. No. 09/466,010, filed Dec. 17, 1999, and in co-pending and co-assigned U.S. Pat. applications Ser. No. 09/396,179, filed Sep. 14, 1999, Ser. No. 09/382,720, filed Aug. 25, 1999, Ser. No. 09/449,121, filed Nov. 24, 1999, Ser. No. 09/433,467, filed Nov. 4, 1999, and 25 Ser. No. 09/448,700, filed Nov. 24, 1999, displays, including tire pressure sensor system displays, compass sensors and displays, temperature displays, which are disclosed in U.S. Pat. application Ser. No. 09/244,726, filed Feb. 5, 1999 and in U.S. Pat. application entitled REARVIEW MIRROR ASSEMBLY WITH UTILITY FUNCTIONS, Ser. No. 09/449,121, filed Nov. 24, 1999, and U.S. Pat. No. 5,530,240, a communication module, which is 30 disclosed in U.S. Pat. No. 5,798,688, blind spot detection systems, which are disclosed in U.S. Pat. Nos. 5,929,786 or 5,786,772, transmitters and/or receivers, including garage door openers and a digital network, which are described in U.S. Pat. No. 5,798,575, a memory mirror system, which is disclosed in U.S. Pat. No. 5,796,176, U.S. Pat. No. 5,798,575, U.S.

Pat. No. 5,812,321, U.S. Pat. No. 5,786,772, and U.S. Pat. No. 5,959,367 and in U.S. Pat. applications entitled MEMORY MIRROR SYSTEM FOR VEHICLES, Ser. No. 09/448,690, filed Nov. 24, 1999 and A VEHICLE REARVIEW MIRROR AND A VEHICLE CONTROL SYSTEM INCOPORATING SUCH MIRROR, Ser. No. 09/341,450, filed July 8, 1999; such
5 as a hands-free phone attachment, a video device for internal cabin surveillance and/or video telephone function, which are disclosed in U.S. Pat. Nos. 5,760,962 and 5,877,897 and co-pending U.S. Pat. application Ser. No. 09/433,467 and copending U.S. Pat. application Ser. No. 08/918,772, entitled MODULAR REARVIEW MIRROR ASSEMBLY, filed Aug. 25, 1997, vehicle navigation systems, which are described in co-pending provisional application
10 Ser. No. 60/131,593, filed Apr. 29, 1999, entitled VEHICLE-BASED NAVIGATION SYSTEM WITH SMART MAP FILTERING, PORTABLE UNIT HOME-BASE REGISTRATION AND MULTIPLE NAVIGATION SYSTEM PREFERENTIAL USE, map lights, including maps lights incorporating light emitting diodes (including organic light emitting diodes) generating a white light beam, which are disclosed in U.S. Pat. Nos.
15 5,938,321; 5,813,745; 5,820,245; 5,673,994; 5,649,756; 5,178,448; 5,669,698; 5,671,996; 4,733,336; and 4,646,210, microphones and/or speakers, which are disclosed in U.S. Pat. applications Ser. No. 09/361,814, filed Jul. 27, 1999, and Ser. No. 09/199,907, filed Nov. 25, 1998, a compass, which is disclosed in U.S. Pat. No. 5,924,212, GPS displays and systems, which are disclosed in U.S. Patent No. 5,971,552 and pending U.S. Pat. applications entitled
20 COMPLETE MIRROR-BASED GLOBAL-POSITIONING SYSTEM (GPS) NAVIGATION SOLUTION, filed March 9, 2000, Ser. No. 60/187,960, Attorney Docket DON01 P-810 and entitled VEHICLE-BASED NAVIGATION SYSTEM WITH SMART MAP FILTERING, HANDHELD UNIT HOME-BASE REGISTRATION AND MULTIPLE NAVIGATION SYSTEM PREFERENTIAL USE, Ser. No. 60/131,593, filed Apr. 29, 1999, cameras,
25 including video cameras, which are disclosed in U.S. Pat. No. 5,877,897, U.S. Pat. No. 5,760,962, U.S. Pat. No. 5,959,367, U.S. Pat. No. 5,929,786, U.S. Pat. No. 5,949,331, U.S. Pat. No. 5,914,815, U.S. Pat. No. 5,786,772, U.S. Pat. No. 5,798,575, and U.S. Pat. No. 5,670,935, and pending U.S. Pat. applications entitled VEHICLE REARVIEW MIRROR DISPLAY SYSTEM, Ser. No. 09/304,201, filed May 3, 1999, VEHICLE MIRROR
30 DIGITAL NETWORK AND DYNAMICALLY INTERACTIVE MIRROR SYSTEM, Ser. No. 09/375,315, filed Aug. 16, 1999, WIDE ANGLE IMAGE CAPTURE SYSTEM FOR VEHICLES, Ser. No. 09/199,907, filed Nov. 25, 1998, WIDE ANGLE IMAGING SYSTEM, Ser. No. 09/361,814, filed Jul. 27, 1999, VEHICLE IMAGING SYSTEM WITH STEREO

IMAGING, Ser. No. 09/372,915, filed Aug. 12, 1999, VEHICLE REARVIEW MIRROR
DISPLAY SYSTEM, Ser. No. 09/300,201, filed May 3, 1999, REARVIEW VISION
SYSTEM WITH INDICIA OF BACKUP TRAVEL, Ser. No. 09/313,139, filed May 17,
1999, and pending U.S. Pat. applications Ser. No. 09/361,814, filed Jul. 27, 1999, and Ser.
5 No. 09/199,907, filed Nov. 25, 1998, and U.S. Pat. application Ser. No. 09/422,467 (Attorney
Docket No. P-783), filed Nov. 4, 1999, entitled VEHICLE INTERIOR MIRROR
ASSEMBLY to Patrick Heslin and Niall R. Lynam, head lamp controllers, which are
disclosed in pending U.S. Pat. application entitled VEHICLE HEADLIGHT CONTROL
USING IMAGING SENSOR, Ser. No. 09/441,341, filed Nov. 16, 1999, telematic interfaces,
10 which are disclosed in copending U.S. Pat. application Ser. No. 08/918,772, entitled
MODULAR REARVIEW MIRROR ASSEMBLY, filed Aug. 25, 1997, storage and pendant
accessories, which are disclosed in U.S. Pat. application entitled REARVIEW MIRROR
ASSEMBLY WITH UTILITY FUNCTIONS, Ser. No. 09/449,121, filed Nov. 24, 1999, rain
sensors, including non-contacting rain sensors, which are disclosed U.S. Pat. No. 4,973,844
15 entitled VEHICULAR MOISTURE SENSOR AND MOUNTING APPARATUS
THEREFORE, and PCT International Application PCT/US94/05093 entitled MULTI-
FUNCTION LIGHT SENSOR FOR VEHICLE, published as WO 94/27262 on Nov. 24,
1994, toll pay devices, including automatic toll pay devices or remote transaction systems,
which are disclosed in pending U.S. Pat. 6,158,655 and application entitled A VEHICLE
20 MOUNTED REMOTE TRANSACTION INTERFACE SYSTEM, filed October 13, 2000
Ser. No. 09/687,778 (Attorney Docket DON01 P851), trip computers, vehicle status displays,
air bag activation status displays, instrumentation/console lighting, and other information
display/user interface devices, which are disclosed U.S. Pat. application Ser. No. 09/244,726,
filed Feb. 5, 1999, reference is made to the various patents, publications, and applications
25 listed above, the entire disclosures of all the referenced applications, patents, and publications
are incorporated by reference herein in their entireties.

Interactive mirror system 10 includes a control 30 that most preferably is
located within casing 14. As shown schematically in FIG. 6, user interaction with touch
sensitive element 26 (such as by touching or at least closely approaching with a human finger
30 or, less preferably, by touching with a stylus or at least closely approaching with a stylus),
preferably a transparent touch sensitive element, generates an output signal 27 indicative of
user interaction that is input to control 30. In response, control 30 provides an output 31 to
display element 28 to cause display element 28 to display the vehicle function or information

desired by the driver. Display element 28 may perform a single display function or multiple display functions, such as providing indication of a vehicle function or functions, including a family of functions of a plurality of family of functions, for example a compass mirror display function, a temperature display function, a tire pressure/status display function, a status of inflation of tires display function, a GPS/navigation system function, a telematic function, computer display function, including e-mails and INTERNET access, a passenger air bag disabled display function, an automatic rain sensor operation display function, telephone dial information display function, highway status information display function, blind spot indicator display function, or the like.

Thus, and in accordance with present invention, a cognitive relationship is established between the touching of the touch sensitive element and generation of the display image on an adjacent or co-located display element, and most preferably, with the display element positioned behind at least a partially transparent touch sensitive element, such that activation of the touch sensitive element causes the display element to emit an image at least partially visible and preferably substantially visible through the transparent touch sensitive element.

Such displays may be an alpha-numeric display or a multi-pixel display, and may be fixed or scrolling. In addition, display element 28 may comprise an incandescent display, vacuum fluorescent display, electroluminescent display, light emitting diode display, cathode ray tube display, field emission display, E-ink display, or organic emitting polymer display or the like. Examples of display elements may be found in copending application entitled REARVIEW MIRROR ASSEMBLY INCORPORATING VEHICLE INFORMATION, Ser. No. 09/244,726, filed Feb. 5, 1999, by Jonathan DeLine and Niall R. Lynam (Attorney Docket No. DON01 P-734), or U.S. Pat. No. 5,530,240, and U.S. Pat. application Ser. No. 09/433,467 (Attorney Docket No. DON01 P-783), filed Nov. 4, 1999, entitled VEHICLE INTERIOR MIRROR ASSEMBLY, to Patrick Heslin and Niall R. Lynam, commonly assigned to Donnelly Corporation, which are herein incorporated by reference in their entireties.

Referring to FIG. 1, the reflective element 12 of interior rearview mirror assembly 11 shown includes a touch sensitive portion on its front surface formed by a plurality of touch sensitive elements 26. Each touch sensitive element 26 has a function associated with it. For example, touch sensitive elements 26 may have associated therewith functions relating to an activity, including internal and external activities, such as video

conferencing, internal or external cabin surveillance, remote transactions, or the like, or internal or external information, such as vehicle status information, weather information, stock information, messaging, or the like. Thus, for example, the driver can reach up and touch one of the touch sensitive elements 26, which in the illustrated embodiment are identified as "TELEMATICS," "BABY VIEW," "REVERSE AID," "STOCK QUOTES," "PAY TOLL," "SAFETY WARNING," "COMP/TEMP DATA," "SERVICE" in order to activate and/or inquire of a particular function or item. As shown in FIG. 1, a stock quote is displayed on display 28 in response to the driver touching the "STOCK QUOTES" section or touch sensitive element of the mirror reflector element surface. When this particular area of the front of the reflective element is touched by a driver, an input is provided by touch sensitive element 26 to control 30 indicating that the driver desires a stock quote. Optionally, and desirably, control 30 can cause displays of other sections of the reflective element to reconfigure to show particular company stock identifiers (such as "DON" or "IBM" or the like), and thus inviting the driver to make a further touch selection of a particular company's stock. Once control 30 knows which stock is of interest, control 30 initiates a wireless connection to a remote telecommunication system such as ONSTAR™ available from General Motors Corporation, Detroit, Mich. or RESCU™ available from Ford Motor Company, Detroit, Mich. or makes a wireless connection to the INTERNET to access a stock quote site on the worldwide Web. Upon receiving back from the remote site the stock quote information, control 30 outputs this to display element 28 to display an image to the driver as illustrated in FIG. 1. As shown, display 28 may display the stock information in a scrolling display, such as a "ticker type" display, and most preferably a "display on demand" which is behind a substantially reflective portion and significantly light transmitting portion of the reflective element (and such as described in U.S. Pat. Nos. 5,668,663 and 5,724,187, which are herein incorporated by reference in their entireties). Using prompts displayed to the driver by display element 28, the driver can use touch sensitive element 26 or other touch activated devices to move between items or page between menu pages. Once the stock quoting activity is completed, the driver can page back to a standard menu of selection items, such as that shown in FIGS. 1-4.

When driving to approach a toll station, the driver can select a "PAY TOLL" touch input section of the reflective element. This causes control 30 to initiate two-way wireless communication with a remote toll booth payment site, and the receipt for any toll paid along with any account balance remaining can be displayed such as illustrated in FIG. 2.

For examples of suitable remote transaction systems, reference is made herein to U.S. Pat. No. 6,158,655 (attorney Docket DON01 P-696) and application entitled A VEHICLE MOUNTED REMOTE TRANSACTION INTERFACE SYSTEM, filed October 13, 2000 Ser. No. 09/687,778 (Attorney Docket DON01 P851), which are incorporated by reference in
5 their entireties.

Optionally, the vehicle is equipped with a camera, such as a baby minder camera, such as is described in co-pending and co-assigned U.S. Pat. applications Ser. Nos. 09/466,010, filed Dec. 17, 1999; 09/396,179, filed Sep. 14, 1999; 09/382,720, filed Aug. 25, 1999; 09/449,121, filed Nov. 24, 1999; 09/433,467, filed Nov. 4, 1999; 09/448,700, filed
10 Nov. 24, 1999, and application entitled INTERIOR REARVIEW MIRROR ASSEMBLY INCORPORATING A VIDEO SCREEN, Ser. No. 09/793,002, filed Feb. 26, 2001 (Attorney Docket No. DON01 P-869), the entire disclosures of all of which are hereby incorporated by reference herein. By touching the "BABY VIEW" portion of touch sensitive element 26, the view of a baby seated at a rear seat is displayed by display element 28 (FIG. 3).

As shown in FIG. 3, selection of the "TELEMATICS" portion of touch sensitive element 26 causes control 30 to initiate a video phone link, with the image of the remote party being displayed at reflective element 12 by display element 28, such as described in U.S. Pat. Nos. 5,760,962 and 5,877,897, which are herein incorporated by reference in their entireties.

A safety warning or message (such as a tire pressure warning or a seat belt warning or an airbag deactivation warning or an engine or vehicle system malfunction warning or the like), can be provided at the touch sensitive surface 26 to alert the driver, as illustrated in FIG. 7. Optionally, the driver can touch the selector element at or adjacent to where the warning is displayed to bring up a menu of other choices/inputs in response to the
25 cause of the warning. The vehicle can be provided with a rear facing camera for use when reversing (or a front facing camera for use in parking, rain sensing, or head lamp control or the like), such as is disclosed in U.S. Pat. Nos. 5,959,367; 5,929,786; 5,949,331; 5,914,815; 5,786,772; 5,798,575; 5,670,935; and pending U.S. Pat. applications entitled VEHICLE REARVIEW MIRROR DISPLAY SYSTEM, Ser. No. 09/304,201, filed May 3, 1999;
30 entitled VEHICLE MIRROR DIGITAL NETWORK AND DYNAMICALLY INTERACTIVE MIRROR SYSTEM, Ser. No. 09/375,315, filed Aug. 16, 1999; entitled WIDE ANGLE IMAGE CAPTURE SYSTEM FOR VEHICLES, Ser. No. 09/199,907, filed Nov. 25, 1998; entitled WIDE ANGLE IMAGING SYSTEM, Ser. No. 09/361,814, filed Jul.

27, 1999; entitled VEHICLE IMAGING SYSTEM WITH STEREO IMAGING, Ser. No. 09/372,915, filed Aug. 12, 1999; entitled VEHICLE REARVIEW MIRROR DISPLAY SYSTEM, Ser. No. 09/300,201, filed May 3, 1999; and entitled REARVIEW VISION SYSTEM WITH INDICIA OF BACKUP TRAVEL, Ser. No. 09/313,139, filed May 17, 1999, which are all commonly assigned to Donnelly Corporation of Holland, Mich., the disclosures of which are herein incorporated by reference in their entireties. By the driver touching reflective element 12 at the portion of touch sensitive element 26 indicating "REVERSE AID," an image immediately to the rear of the vehicle, as illustrated in FIG. 8, is displayed by display element 28.

Touch sensitive element 26 can be a capacitive type or a resistive type or an inductive type, such as are known in the touch panel arts, including such as disclosed in U.S. Pat. Nos. 3,798,370; 4,198,539; 4,661,655; 4,731,508; 4,822,957; and 5,045,644, and U.S. Pat. Nos. 6,001,486 (Attorney Docket No. DON03 P-693); and 6,087,012 (Attorney Docket No. DON03 P-750), the disclosures of which are herein incorporated by reference in their entireties, and U.S. Pat. applications entitled ENHANCED LIGHT TRANSMISSION CONDUCTIVE COATED TRANSPARENT SUBSTRATE, Ser. No. 60/213,663, filed June 23, 2000 (Attorney Docket No. DON03 P-828); entitled PLASTIC SUBSTRATE FOR INFORMATION DEVICES, Ser. No. 60/231,096, filed Sept. 8, 2000 (Attorney Docket No. DON03 P-839); entitled REDUCED CONTRAST IMPROVED TRANSMISSION CONDUCTIVELY COATED TRANSPARENT SUBSTRATE, Ser. No. 60/239,788, filed Oct. 12, 2000 (Attorney Docket No. DON03 P-853); entitled SPACER ELEMENTS FOR INTERACTIVE INFORMATION DEVICES, Ser. No. 60/234,867, filed Sept. 22, 2000 (Attorney Docket No. DON03 P-845); entitled IMPROVED PLASTIC SUBSTRATE FOR INFORMATION DEVICES, Ser. No. 60/244,577, filed Oct. 31, 2000 (Attorney Docket No. DON03 P-860), which are incorporated by reference herein in their entireties. Also, the touch inputs of this present invention do not necessarily require physical contact between the driver's finger and touch sensitive element 26. Close approach of the driver's finger (or a stylus) to the touch sensitive surface may suffice to achieve a touch input. This can thus be by non-contacting input or by contacting input by a variety of means such as thermal or pyro detection, capacitive or inductive detection, resistive sensing, electromagnetic disturbance sensing or the like. Optionally, a reading of the fingerprint of the person touching the mirror reflector can be taken to verify identity of the person and so authorize particular actions in response (such as turning on the vehicle ignition, such as to start the engine, conducting a

remote banking transaction, identifying a person for the purpose of setting vehicle accessories such as seat position, mirror position, climate control, audio system controls, ride system, and the like to the particular setting preferred by that individual person such as is common in vehicle memory systems).

5 Touch sensitive element 26 can comprise a transparent conductive coating or stack of coatings, such as of indium tin oxide, tin oxide, doped tin oxide, doped zinc oxide, or any other transparent conductor coating or stack known in the touch screen arts, and can be part of a 4-wire system or a 5-wire system as such are known in the touch screen art, or can be a capacitive-type touch screen.

10 Preferably, touch screen element 26 and display element 28 are re-configurable so that each can be associated with more than one function. Dependent on the particular circumstance, an in-vehicle microprocessor can create on touch screen element 26 and display element 28 whatever icon, highlight or display is desired presented to the driver. In addition, one of the touch screen elements (26) may be used to toggle between the various
15 available functions for a given touch screen element 26.

Note that the display that the driver touches via touch screen element 26 can be generated by display element 28 itself or alternately, by a separate display located behind the mirror reflector. In such a configuration where a display element is behind the mirror reflector, the reflective mirror coating of the mirror reflective element can be locally at least partially removed at the location of the display element disposed behind the mirror element. Optionally, where all the reflective mirror coating is removed, a semitransparent but significantly reflecting coating or series of coatings (such as a thin metal film coating or a multilayer of coatings, including a thin metal coating of silver, aluminum, rhodium, (or their alloys), or the like, or a dichroic coating or coating stack, can be used that substantially
20 masks the display element from driver notice until the display element is powered to display information, such as disclosed in U.S. Pat. Nos. 5,668,663 and 5,724,187, which are incorporated by reference in their entireties. Such has been described as "display on demand" in the art. Such display can include a "display on demand" such as disclosed in U.S. Pat. Nos. 5,668,663 and 5,724,187 noted above. In this regard, it is preferable that the
25 display be a light emitting display, such as a fluorescent display, a vacuum fluorescent display, a field emission display, an electroluminescent display, a fluorescent display, a plasma display, or a light emitting diode display, such as an organic or inorganic light emitting diode display. Alternatively, the reflective element may comprise a substantially
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reflecting, significantly light transmitting reflective element, such as disclosed in U.S. Pat. Nos. 5,668,663 and 5,724,187 noted above. An example, such as a semitransparent reflector would be a third surface reflector coated on the third surface of an electrochromic mirror element, as known in the electrochromic mirror art, consisting of a thin metal coating (such as of silver, silver alloy, aluminum, aluminum alloy) that is significantly reflecting but also significantly transmitting and that, preferably, is overcoated with a transparent conductor such as indium tin oxide when contacting an electrochromic medium (preferably an electrochromic solid polymer film) when serving as a combined third surface reflector/conductor layer in an electrochromic laminate cell construction. For further details of suitable reflective elements with portions of the reflective mirror coating adapted to permit light to transmit through the reflective element or of a highly reflecting/significantly transfective reflective element, reference is made to U.S. Pat. Nos. 5,668,663 and 5,724,187.

A preferred construction for the interactive mirror reflective element of the present invention is shown in FIG. 9. Interactive mirror assembly 40 comprises a touch screen 44 upon which, on its outermost surface, is comprised a touch sensitive element, such as a touch sensitive element comprising a transparent electronic conducting coating of indium tin oxide. Behind touch screen 44 is disposed reflective element 42. Between the touch screen 44 and the reflective element 42 is disposed display element 48. Display element 48 is preferably a liquid crystal, an electrochromic, a plasma, or an electroluminescent element that has high transparency in one state and that either emits light or absorbs light it a second state. Individual pixels of display element 48 are, preferably, addressable so that display element 48 is reconfigurable. When in its high transparency state, display element 48 allows light incident thereon from touch screen 44 pass through and reflect off the mirror reflective coating of reflective element 42 (which may be a silvered prism element or may be an electrochromic element). When particular pixels of display element 48 are activated, the display formed thereby is visible in front of reflective element 12.

Co-location of the touch sensitive element (in a superimposed relationship or in a proximate relationship) and the display element it controls in accordance with the present invention has several advantages. For example, and as noted above there is a cognitive relationship established between the touching of the touch sensitive element and the generation of the display image. With the display element positioned behind at least a partially transparent touch sensitive element, such that activation of the touch sensitive element causes the display element to emit an image at least partially visible and preferably

at least substantially visible through the transparent touch sensitive element, there is a cognitive association between the touch sensitive element and the display, thus reducing the amount of distraction to the driver. Also, the driver can repetitively touch a particular touch sensitive element and scroll down through a menu of options seen to be displayed by the particular display element associated with that particular touch sensitive element. Upon reaching a menu item desired selected, that menu item may be selected by the driver (such as by touching "OK" on a separate touch sensitive element). After using the interactive system for a while, a driver can select a selector element without looking directly at the mirror, with the image generated by the display element being only detected in the peripheral vision of the driver. Furthermore, by co-locating the display element behind the touch sensitive element, the viewing area of the reflective element is maximized.

As an alternate and/or an addition to providing a touch sensitive surface/element accessible by touching the mirror reflective element, a touch sensitive surface/element can optionally be provided in the bezel of the casing of the interior mirror assembly, such as in a chin portion below the reflective element of the assembly or in an eyebrow region above the reflective element or at a mirror mount or support region or an accessory module or pod attached or adhered or adjacent to the interior mirror assembly.

The rearview mirror assemblies of the present invention can incorporate a wide variety of electrical and electronic devices incorporated therein and further utility functions, such as described in copending U.S. Pat. application entitled REARVIEW MIRROR ASSEMBLY WITH UTILITY FUNCTIONS, filed Nov. 24, 1999, by Barry W. Hutzler, Niall R. Lynam, and Darryl P. DeWind, Attorney Docket DON01 P-778, and added display features as described in copending U.S. Pat. application entitled REARVIEW MIRROR ASSEMBLY WITH ADDED FEATURE MODULAR DISPLAY, filed Nov. 24, 1999, by Timothy Skiver et al., attorney Docket No. DON01 P-702, which are herein incorporated by reference herein in their entireties. For example, the rearview mirror assemblies of the present invention may include: antennas, including GPS or cellular phone antennas, such as disclosed in U.S. Pat. No. 5,971,552; a communication module, such as disclosed in U.S. Pat. No. 5,798,688; displays such as shown in U.S. Pat. No. 5,530,240 or in U.S. pending application Ser. No. 09/244,726, filed Feb. 5, 1999; blind spot detection systems, such as disclosed in U.S. Pat. Nos. 5,929,786 or 5,786,772; transmitters and/or receivers, such as garage door openers, a digital network, such as described in U.S. Pat. No. 5,798,575; a high/low head lamp controller, such as disclosed in U.S. Pat. No. 5,715,093; a

memory mirror system, such as disclosed in U.S. Pat. No. 5,796,176; a hands-free phone attachment, a video device for internal cabin surveillance and/or video telephone function, such as disclosed in U.S. Pat. Nos. 5,760,962 and 5,877,897 and co-pending application Ser. No. 09/433,467; a remote keyless entry receiver; map lights, such as disclosed in U.S. Pat. Nos. 5,938,321; 5,813,745; 5,820,245; 5,673,994; 5,649,756; or 5,178,448, including a non-incandescent light, such as an LED source unit, preferably a white light emitting LED, including a non-incandescent light source unit, such as described in co-pending U.S. provisional application entitled "VEHICULAR NON-INCANDESCENT LIGHT SOURCE UNIT", Ser. No. _____, filed by John O. Lindahl and Niall R. Lynam on Feb. 26, 2001, (Attorney Docket No. DON01 P-882); microphones and/or speakers, such as disclosed in U.S. Pat. applications Ser. No. 09/361,814, filed Jul. 27, 1999, and 09/199,907, filed Nov. 25, 1998; a compass, such as disclosed in U.S. Pat. No. 5,924,212; seat occupancy detector; a trip computer; an ONSTAR System or the like, with all of the referenced patents and applications being commonly assigned to Donnelly Corporation, the disclosures of which are herein incorporated by reference in their entireties.

In addition, the touch system of the present invention may encompass a global positioning system (GPS), such as described in co-pending U.S. application entitled COMPLETE MIRROR-BASED GLOBAL POSITIONING SYSTEM (GPS) NAVIGATION SOLUTION, filed by Kevin C. McCarthy, Eugene V. Uhlmann, and Niall R. Lynam, on March 3, 2001, the entire disclosure of which is incorporated by reference in its entirety.

Mirror system 10 may include circuitry for mirror mounted video cameras, which are used to visually detect the presence of moisture on the windshield and actuate windshield wipers accordingly, and/ or actuate or control vehicle headlights, such as described in copending U.S. Pat. application Ser. No. 08/621,863, filed Mar. 25, 1996, entitled VEHICLE HEADLIGHT CONTROL USING IMAGING SENSOR, by Schofield et al., now U.S. Pat. No. 6,097,023, U.S. Pat. application No. 09/599,979, filed June 22, 2000 (Attorney Docket No. DON01 P-816), or U.S. Pat. application Ser. No. 09/441,341, filed Nov. 16, 1999 (Attorney Docket No. DON01 P-770), or mirror mounted cameras for vehicle internal cabin monitoring disclosed in U.S. Pat. Nos. 5,877,897; 5,550,677; and 5,760,962, both commonly assigned to Donnelly Corporation, which are hereby incorporated herein by reference in their entireties, or mirror mounted cameras for rear vision systems as disclosed in U.S. Pat. Nos. 5,959,367; 5,929,786; 5,949,331; 5,914,815; 5,786,772; 5,798,575; 5,670,935; and pending U.S. Pat. applications entitled VEHICLE MIRROR DIGITAL NETWORK

AND DYNAMICALLY INTERACTIVE MIRROR SYSTEM, Ser. No. 09/375,315, filed Aug. 16, 1999 (Attorney Docket No. DON01 P-769); entitled VEHICLE WITH REARVIEW MIRROR DISPLAY SYSTEM, Ser. No. 09/304,201, filed May 3, 1999 (Attorney Docket No. DON01 P-749); entitled REARVIEW VISION SYSTEM WITH INDICIA OF BACKUP TRAVEL, Ser. No. 09/313,139, filed May 17, 1999 (Attorney Docket No. DON01 P-751);
5 entitled VEHICLE CAMERA DISPLAY, filed Feb. 5, 2001, by Kenneth Schofield et al. (Attorney Docket No. DON01 P-874); entitled VEHICLE REARVIEW MIRROR DISPLAY SYSTEM, Ser. No. 09/304,201, filed May 3, 1999; entitled VEHICLE MIRROR DIGITAL NETWORK AND DYNAMICALLY INTERACTIVE MIRROR SYSTEM, Ser. No.
10 09/375,315, filed Aug. 16, 1999; entitled WIDE ANGLE IMAGE CAPTURE SYSTEM FOR VEHICLES, Ser. No. 09/199,907, filed Nov. 25, 1998; entitled WIDE ANGLE IMAGING SYSTEM, Ser. No. 09/361,814, filed Jul. 27, 1999; entitled VEHICLE IMAGING SYSTEM WITH STEREO IMAGING, Ser. No. 09/372,915, filed Aug. 12, 1999; entitled VEHICLE REARVIEW MIRROR DISPLAY SYSTEM, Ser. No. 09/300,201, filed May 3, 1999; and entitled REARVIEW VISION SYSTEM WITH INDICIA OF BACKUP TRAVEL, Ser. No. 09/313,139, filed May 17, 1999, which are all commonly assigned to Donnelly Corporation of Holland, Mich., the disclosures of which are herein incorporated by reference in their entireties. Examples of a tire pressure display or monitoring system is described in U.S. copending Pat. application entitled TIRE INFLATION ASSISTANCE MONITORING SYSTEM, Ser. No. 09/513,941, filed Feb. 28, 2000 (Attorney Docket DON01 P-801), and TIRE INFLATION ASSISTANCE MONITORING SYSTEM, filed Nov. 10, 2000 (Attorney Docket DON01 P-861), which are herein incorporated by reference in their entireties.

In addition, lighting provided in any of the rearview mirror assemblies may incorporate a non-incandescent light source unit, such as described in copending U.S.
25 provisional application entitled VEHICULAR NON-INCANDESCENT LIGHT SOURCE UNIT, Ser. No. _____, by John O. Lindahl and Niall R. Lynam, filed Feb. 26, 2001, (Attorney Docket No. DON01 P-882), the entire disclosure of which is incorporated by reference herein.

Other features which can be incorporated include: a baby minder system, such
30 as the vehicle interior monitoring system described in U.S. Pat. Nos. 5,877,897 and 5,760,962 or the rear vision system described in pending U.S. Pat. applications Ser. No. 09/361,814, filed Jul. 27, 1999, and Ser. No. 09/199,907, filed Nov. 25, 1998, and U.S. Pat. application Ser. No. 09/422,467 (Attorney Docket No. P-783), filed Nov. 4, 1999, entitled VEHICLE

INTERIOR MIRROR ASSEMBLY, to Patrick Heslin and Niall R. Lynam, all of which are incorporated by reference in their entireties herein.

In addition, all of the above interactive automotive rear vision systems may be part of a video display assembly, such as disclosed in copending application entitled

- 5 INTERIOR REARVIEW MIRROR ASSEMBLY INCORPORATING A VIDEO SCREEN, filed Feb. 26, 2001, Ser. No. 09/793,002 (Attorney Docket DON01 P-869), the disclosure of which is incorporated by reference herein in its entirety

Therefore, it can be appreciated that an interactive mirror system is provided that enables a driver to interact with multiple systems or devices and also provides the driver
10 with a multitude of information, with these various features centrally located at the interior rearview mirror assembly.

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